CLAIMS

1. An open loop air fuel ratio controller comprising:

a detector arranged down stream of a catalyst and adapted to detect rich breakthrough;

a catalyst model having an estimator adapted to estimate a stored oxygen level in the catalyst.

a comparator adapted to compare an estimated stored oxygen level with a plurality of predetermined thresholds; and

a demand adjusting means for adjusting an air fuel ratio demand in dependence upon a received signal from said comparator and upon a received signal from said detector.

2. An open loop air fuel ratio controller according to claim 1 in which the comparator is arranged to compare an estimated stored oxygen level with a plurality of thresholds when the detector detects rich breakthrough.

3. An open loop air fuel ratio controller according to claim 1, further comprising a model adjusting means for adjusting the model in dependence upon a received signal from said comparator and upon a received signal from said detector.

4. An open loop air fuel ratio controller according to claim 3, in which the controller is arranged such that when the model adjusting means adjusts the model the demand adjusting means does not adjust the air fuel ratio demand.

5. An open loop air fuel ratio controller according to claim 4, in which the controller is arranged such that when the demand adjusting means adjusts the air fuel ratio demand the model adjusting means does not adjust the model.

6. An open loop fuel ratio controller according to claim 3, in which the model adjusting means is arranged to adjust the model to reduce or increase a maximum oxygen storage value.

7. An open loop air fuel ratio controller according to claim 1, in which the detector is heated exhaust gas oxygen sensor.

8. An open loop fuel control method comprising the steps of:

detecting rich breakthrough downstream of a catalyst;

estimating an oxygen storage level in the catalyst;

comparing the estimated oxygen storage level with a plurality of predetermined thresholds; and

adjusting the air fuel ratio demand in dependence upon the results of said comparing step and said detecting step.

9. An open loop fuel control method according to claim 8, further comprising the step of:

adjusting the model in dependence upon the results of said comparing step and said detecting step.

10. An open loop fuel control method according to claim 9, in which adjusting the air fuel ratio demand step comprises the sub-step of:

if the estimated oxygen storage level is less than a first predetermined threshold then the air fuel ratio demand is adjusting in a rich direction.

11. An open loop fuel control method according to claim 10, in which the model adjusting step and the air fuel ratio demand adjusting step are not performed if a rich breakthrough is detected and if the estimated oxygen level is greater than a second predetermined threshold and is less than a third predetermined threshold.

12. An open loop fuel control method according to claim 11, in which adjusting the air fuel ratio demand comprises the sub-step of:

if a rich breakthrough is detected and the estimated oxygen storage level is greater than a fourth predetermined threshold then the air fuel ratio demand is adjusting in a lean direction.

13. An open loop fuel control method according to claim 9, in which the model adjusting step is arranged to adjust the model such that a maximum value for the oxygen storage level is increased if a rich breakthrough is detected and if the estimated oxygen level is greater than a first predetermined threshold and less than a second predetermined threshold.

14. An open loop fuel control method according to claim 13, in which the model adjusting step is arranged to adjust the model such that a maximum value for the oxygen storage level is decreased if a rich breakthrough is detected and if the estimated oxygen level is greater than a third predetermined threshold and less than a fourth predetermined threshold.

15. An open loop fuel control method according to claim 11 wherein the first predetermined threshold is less than or equal to the second predetermined threshold and the second predetermined threshold is less than or equal to the third predetermined threshold.

16. An open loop fuel control method according to claim 12 wherein the first predetermined threshold is less than or equal to the second predetermined threshold and the second predetermined threshold is less than or equal to the third predetermined threshold and the third predetermined threshold is less than or equal to the fourth predetermined threshold.

17. An open loop fuel control method according to claim 14 wherein the first predetermined threshold is less than or equal to the second predetermined threshold and the second predetermined threshold is less than or equal to the third predetermined threshold.

18. An open loop fuel control method according to claim 14 wherein the first predetermined threshold is less than or equal to the second predetermined threshold and the second predetermined threshold is less than or equal to the third predetermined threshold and the third predetermined threshold is less than or equal to the fourth predetermined threshold.